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ABSTRACT

The Rumson-Fair Haven Senior Elective Program was developed and implemented by students, faculty, and administrators over the three-year period from 1971 to 1974. The program offers high school students who complete graduation requirements in the first three years of the four-year program a combination of the following options for the senior year: minicourse electives, independent study, work experience in the community, and preceptorials. The program is conducted in an open space building with an open campus policy. This brochure contains outlines of minicourses in the science department, listing texts and other bibliographical references and detailing units within the course outlines. Appended to each outline are brief statements on teaching styles and course evaluation methods currently in use in the program. Science minicourses are designed to meet student requests, to supplement year-long traditional courses, to encourage hobby interests, or to introduce vocational pursuits. Specific courses listed are Advanced Physics, Astronomy, Fossils as a Key to the Past, Genetics, Introduction to Entomology, Laboratory Technology, Marine Ecology, Nutrition, and Photography.
(Author/PGD)

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COURSE OUTLINES IN SCIENCE

of the

Rumson-Fair Haven

Senior Elective Program

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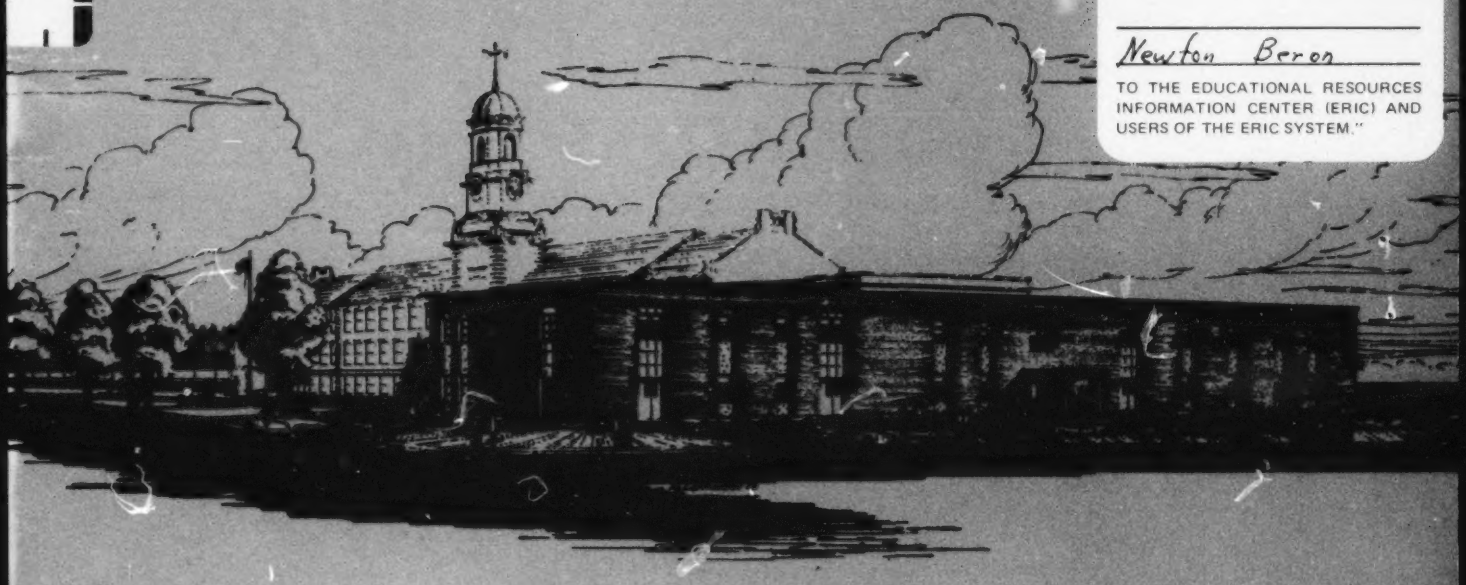
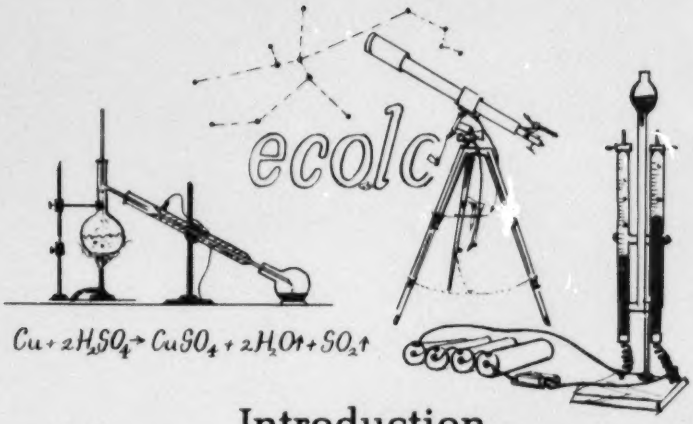


"On behalf of the Department of Education, State of New Jersey, I wish to bring the Senior Elective Program to the attention of educators throughout the nation. The program has made a significant contribution to the education of young men and women as they make critical choices for their future."

Fred G. Burke

Dr. Fred G. Burke
Commissioner of Education
State of New Jersey

EA 011 009



Introduction

The Rumson-Fair Haven Regional High School Senior Elective Program was developed and implemented by students, faculty and administrators over a three year period from 1971 to 1974. In 1974 it was validated by the standards and guidelines of the United States Office of Education as successful, cost-effective, and exportable and approved for national dissemination by the Dissemination Review Panel. Funding for the development as well as the dissemination was through the Elementary and Secondary Act, Title III/IV C program in New Jersey.

Brochures describing the Senior Elective Program are available to interested parties free of charge. Visits to the Rumson-Fair Haven Regional School to see the program may be arranged with the project director. Interested educators may purchase a filmstrip-cassette presentation describing the development and implementation process, and a Resource Compendium and Profile containing student and teacher reactions to the program as well as outlines of seventy-six mini-courses developed by the staff.

The Rumson-Fair Haven Senior Elective Program offers high school students who complete graduation requirements in three years a combination of the following options for the senior year: mini-course electives, independent study and preceptorials. The senior program is conducted in an open space building. An open campus policy for seniors allows them to follow highly flexible schedules based upon a modular scheduling procedure consisting of nineteen twenty minute modules per day. The school year is divided up into five marking periods or facets. Funding by ESEA Title III provided stipends for planning and writing mini-courses of study covering a wide variety of subjects. Some of them may be considered as units of larger year long subjects, some are "new" to most secondary school curricula, while still others cross over departmental lines.

This brochure contains fully developed outlines of courses in the Science Department listing texts, other bibliographical references, and detailed units within the course outlines. Appended to each outline are brief statements on teaching styles and course evaluations currently in use for each course. Science mini-courses are designed to meet student requests, to supplement year long traditional courses, to encourage hobby interests, or to introduce vocational pursuits. It should be noted that these courses are now being presented by the staff at Rumson-Fair Haven Regional High School. Complete outlines for other departments are anticipated in later publications.

Mr. George Giffin
Chairman

ADVANCED PHYSICS

by Louis Mitchell

OBJECTIVES

This course is designed to review traditional high school physics and then proceed into topics usually reserved for a college level program. Students enrolled in this subject have already taken the general high school physics, possess greater maturity, and usually have completed, or are taking, advanced mathematics. The mathematics and the advanced physics complement one another and help in the understanding of both diciplines.

PART I. COURSE OUTLINE

I. Mechanics

A. Statics

1. Equilibrium of a particle
   a. Newton's first law
   b. Stable, unstable and neutral equilibrium
   c. Newton's third law
   d. First condition of equilibrium: sum of forces must equal zero
   e. Friction
2. Equilibrium of rotation
   a. Second condition of equilibrium: moments of force equal zero
   b. Resultant of parallel forces
   c. Center of gravity
   d. Couples

B. Kinematics and dynamics

1. Straight line motion
   a. Average and instantaneous velocity
   b. Average and instantaneous acceleration
   c. Straight line motion with constant acceleration
   d. Velocity and position by integration
   e. Freely falling bodies
   f. Rectilinear motion with variable acceleration
   g. Velocity components: relative velocity
2. Newton's second law and gravitation
   a. Definition of mass
   b. Units
   c. Newton's law of universal gravitation
   d. Mass and weight
   e. Applications of Newton's second law
3. Two-dimensional motion
   a. Motion of a plane
   b. Average and instantaneous acceleration
   c. Components of acceleration
   d. Projectile motion
   e. Circular motion
   f. Centripetal force
   g. Motion in a vertical circle
   h. Satellite motion
4. Work and energy
   a. Work
   b. Kinetic energy
   c. Gravitational potential energy
   d. Elastic potential energy
   e. Conservative and dissipative forces
   f. Internal work
   g. Internal potential energy
   h. Power
   i. Power and velocity
5. Impulse and momentum
   a. Conservation of momentum
   b. Elastic and inelastic collisions
   c. Recoil
   d. Principles of rocket propulsion
6. Rotation
   a. Angular velocity and acceleration
   b. Torque and angular acceleration
   c. Moments of inertia
   d. Angular and linear velocity
   e. Kinetic energy, work and power
7. Harmonic motion
   a. Elastic restoring forces
   b. Equations of S.H.M.
   c. Springs and pendulums

C. Fluid mechanics

1. Hydrostatics
   a. Pressure
   b. The hydrostatic paradox
   c. Archimedes' principle
2. Hydrostatics
   a. Equation of continuity
   b. Bernoulli's equation
   c. Applications of Bernoulli's equation

II. Heat and Thermodynamics

A. Heat

1. Heat and heat measurements
   a. Heat transfer
   b. Quantity of heat
   c. Heat capacity
   d. Change of phase
2. Transfer of heat
   a. Conduction
   b. Convection
   c. Radiation
   d. Stefan's law
   e. The ideal radiator

B. Thermodynamics

1. The first law
   a. Work in thermodynamics
   b. Adiabatic process
   c. Isothermal process
   d. Internal energy
   e. Conversion of heat to work
   f. Heat engines
2. The second law
   a. Absolute zero
   b. Entropy

III. Wave Motion

A. Traveling waves and vibrating bodies
   1. Introduction
      a. Mathematical model of a wave
      b. Calculation of speed
      c. Transverse and longitudinal waves
   2. Vibrating bodies
      a. Boundary conditions of a string
      b. Stationary waves on a string
      c. Harmonic series and resonance
      d. Vibration in organ pipes

B. Acoustical phenomena
   1. Introduction
   2. Acoustics
      a. Pressure variations in a sound wave
      b. Intensity in a sound wave
      c. Loudness
      d. Quality and pitch
      e. Beats
      f. Doppler effect

IV. Electricity and Magnetism

A. Statics
   1. Coulomb's law
      a. Electric charges
      b. Conductors and insulators
   2. The electric field
      a. Calculation of field intensity
      b. Lines of force
      c. Gauss' law
   3. Potential
      a. Electric potential energy
      b. Calculation of potential differences
      c. Potential gradient
      d. The Milliken oil-drop experiment
      e. The electron volt
      f. The cathode ray oscilloscope
   4. Capacitance
      a. Capacitors
      b. Capacitors in series and parallel
      c. Energy of a charged capacitor

B. Electric current
   1. Current
      a. Resistance
      b. Electromotive forces
      c. Work and power in electric circuits
   2. D.C. Circuits
      a. Resistors in series and in parallel
      b. Kirchoff's rules
      c. The Wheatstone bridge
      d. The R-C series circuit

C. Magnetism
   1. The magnetic field
      a. Magnetism
      b. Lines of induction
      c. Magnetic flow
      d. Thompson's measurement of e/m
      e. Positive rays and isotopes
      f. Atomic weights
   2. Magnetic forces on currect carrying conductors
      a. Force on conductors
      b. The Hall effect
      c. Galvanometers
   3. Magnetic field of a current
      a. Magnetic field around a moving point charge
      b. Field around a long straight conductor
      c. Ampere's law

D. Electromagnetic inductions
   1. Induced electromotive force
      a. Lenz's law
      b. Eddy currents
      c. Mutual inductance
      d. Self-inductance
      e. The R-L circuit
      f. The L-C circuit
      g. The R-L-C circuit
   2. A.C. Circuits
      a. Average and root mean square values
      b. Power in A.C. circuits
      c. Resonance
      d. The transformer

V. Electromagnetic Waves

A. Electromagnetic waves in general
   1. Speed of electromagnetic waves
   2. Electromagnetic waves in matter
   3. Waves in transmission line
   4. Radiation in an antenna
   5. Maxwell's equations

B. Light
   1. Nature and propagation
      a. Nature of light
      b. Source of light
      c. Waves, wavefronts, and rays
      d. The laws of reflection and refraction
      e. Index of refraction
   2. Lenses and optical instruments
      a. Images as objects
      b. The thin lens
      c. Diverging lenses
      d. Graphical methods
      e. The eye
      f. Cameras, microscopes and telescopes
   3. Interference and diffraction
      a. Principles of interference
      b. Young's experiment
      c. Intensity distribution and interference fringes
      d. Newton's rings
      e. The Michelson interference meter
      f. The Michelson-Morley experiment
      g. Fresnel diffraction
      h. X-ray crystal diffraction

VI. Nuclear Physics

A. Atoms
   1. Conduction in gases
   2. Thermionic emission
   3. The triade
   4. The photoelectric effect

B. Photons
   1. Line spectra
   2. The Bohr atom
   3. Wave mechanics
   4. The electron microscope
   5. Absorption spectra

C. The nucleus
   1. Radioactivity (natural)
      a. Natural radioactivity
      b. Alpha particles
      c. Rutherford's scattering experiment
      d. Beta particles
      e. Gamma rays
      f. Radioactive disintegration
   2. Radioactivity (experimental)
      a. Artificial radioactivity
      b. Man-made elements
   3. Modern nuclear theory
      a. Cosmic rays—the position
      b. Neutrons and mesons
      c. Nuclear stability
      d. Nuclear fission
      e. Thermonuclear reactions

PART II. RESOURCES AND EVALUATION

A. Texts

Fundamentals of Physics, Halliday, David and Resnick, Robert, John Wiley and Sons, New York, N.Y., 1974.

Theory and Problems of Calculus, Ayers, Frank, McGraw Hill Book Co., New York, N.Y., 1964.

B. Teaching Styles

The course comprises lectures on fundamental areas followed by small group discussions, laboratory work and problem solving. Several field trips are taken to nearby facilities.

C. Student Parameters

Students are expected to spend considerable time working in the laboratory. They must also make presentations to the class and possibly serve as tutors for the first year physics students. They are required to develop an independent project for the course. Prerequisites are Physics I and Advanced Mathematics as well as permission from the instructor. Concurrent enrollment in Calculus is desired.

D. Evaluation

Final evaluation includes completion of a major project and successful solutions of laboratory problems. Grades are determined by conferences between the instructor and students.

E. Modular Configuration

The class meets seven mods per week in a 3-2-2 pattern for five facets (the entire year).

PART III. DETAILED UNIT

HEAT

I. Nature and Effects of Heat
   A. Nature
      1. Originally thought to be a fluid
      2. Later associated with energy changes
   B. Sources
      1. The sun
      2. The earth's interior
      3. Chemical action
      4. Mechanical energy
      5. Electrical energy
      6. Nuclear energy
   C. Heat and temperature
      1. Thermal energy
      2. Expansion of gases
   D. Temperature scales and absolute zero
      1. Fahrenheit
      2. Celsius
      3. Kelvin and absolute zero
      4. Thermometers
   E. A special case—water
      1. Strange expansion curve
      2. The effects of loss and expansion
   F. The gas laws

II. Heat Units and Specific Heat
   A. Measurement of heat
   B. Heat capacity
      1. Different materials
      2. Specific heat
      3. Mixing
   C. Law of heat exchange

III. Change of State
   A. Fusion
      1. Difference in internal energy
      2. Heat of fusion
      3. Effects of pressure
      4. Effects of dissolved materials
   B. Vaporization
      1. Difference in internal energy
      2. Heat of vaporization
      3. Effects of pressure
      4. Effects of dissolved materials
      5. Equilibrium vapor pressure

IV. Heat and Work
   A. Relationship
      1. First law of thermodynamics
      2. The experiment of Joule
      3. Converting heat to work
      4. Isothermal processes
      5. Adiabatic processes
      6. The Coronot cycle
   B. The second law of thermodynamics
      1. Entropy
      2. The steam turbine

V. Heat Transfer

A. Convection
   1. Definition
   2. Examples

B. Conduction
   1. Definition
   2. Examples

C. Radiation: Note: This topic is used to introduce the next topic - Waves

ASTRONOMY

by Louis Mitchell

OBJECTIVES

This course is designed to make students aware of the Earth's place in the universe and of the world around them. Students become familiar with and gain an appreciation for objects visible in the sky. The astronomical theories of ancient and modern man help the student learn scientific history as well as the scientific method.

PART I. COURSE OUTLINE

I. Models of the Universe

A. Models
   1. How derived
   2. Uses and limitations

B. Phenomena in the universe
   1. Ancient models
   2. Modern models

C. The Greek model
   1. The celestial sphere
      a. Poles
      b. Rotation
   2. Annual motion of the sun
   3. Fixed and wandering stars
   4. Constellations
   5. Pythogoras
   6. Eudoxus
   7. Aristotle
      a. Moon's phases
      b. Spherical earth
      c. Motions of the earth
   8. Aristarchus
      a. Distance from earth to sun and moon
      b. Relative sizes
   9. Erotosthenes
   10. Hipparchus
   11. Ptolemy

D. The Heliocentric Model
   1. Copernicus
      a. Relativity
      b. Motion of planets around sun
      c. Siderial and synodic periods
      d. Relative distances
   2. Tycho Brache
      a. Observations
      b. Model of solar system
      c. Cosmology
   3. Kepler
      a. Investigations of Mars
      b. The mathematics of conic sections
      c. His three laws
      d. "Music of the spheres"
   4. Galileo
      a. Mechanical laws
      b. Astronomical observations
      c. The inquisition

II. Newtonian Mechanics

A. Laws of motion
   1. Inertia
   2. F = ma
   3. Action - reaction
   4. Centripital acceleration and force

B. Universal gravitation
   1. Weight and mass
   2. Determination of the mass of the earth

C. Celestial mechanics
   1. Center of mass and orbital motion
   2. Centrifugal force
   3. Derivation of Kepler's laws
   4. Masses of the planets and stars

D. Orbits
   1. The planets
   2. Artificial satellites
   3. Ballistic missiles

E. The problem of more than two bodies
   1. Perturbation theory
   2. Gravitational effects of non-spherical bodies
   3. Tides
   4. Precession

III. Earth and Sky

A. Motion of the earth
   1. Rotation
      a. Faucalt pendulum
      b. Cariolis effect

B. Relationship of earth and sky
   1. Latitude, longitude, etc.
   2. Celestial equators and poles
   3. Celestial geography
      a. Altitude and azimuth
      b. Right ascension and declination
   4. Nomenclature of stars

C. Revolution of the earth
   1. Proofs
   2. The seasons

D. Time and the calendar
   1. Time of day
   2. Time zones
   3. Daylight savings
   4. The International Date Line

IV. Light

A. Nature and properties
   1. Inverse square laws
   2. The speed of light

3. The spectrum
4. Electromagnetic energy
   a. Velocity, frequency and wave length
   b. The spectrum
   c. E=hf
5. Geometric optics
   a. Reflection
   b. Refraction
   c. Dispersion
6. Spectra
   a. Types
   b. Sources
   c. Uses

B. Astronomical instruments
1. Telescopes
2. Photometers
3. Spectrometers

C. Black body radiation
1. Planck's law
2. Wein's law
3. Stefan-Boltzman law
4. Quantum theory

D. The light from the stars
1. Stellar magnitudes
2. Absolute magnitudes
3. Color of the light
4. Stellar spectra
   a. Chemical composition
   b. The H-R diagrams

V. The Stars

A. Distances
1. Triangulation
   a. Surveying
   b. The "skinney" triangle
   c. Determining the astronomical unit
2. Surveying stellar distances
   a. Stellar parallax
   b. The parsec
   c. Stellar motions
   d. Moving clusters
   e. Inverse square law of light
   f. Dynamical parallaxes
   g. Interstellar lines
   h. Galactic rotation

B. Weighing and measuring the stars
1. Determination of the sun's mass
2. Binary stars
   a. Types
   b. Mass determination

C. The stellar population
1. The nearest stars
2. The brightest stars
3. The H-R diagram

D. The sun, a typical star
1. Layers
   a. Photosphere
   b. Chromosphere
   c. Corona
2. The solar atmosphere
   a. Granulation
   b. Sunspots
   c. Magnetic fields
   d. Prominences and flores
3. Rotation

VI. Comets and Meteors

A. Comets
1. Halley's comet
2. Orbits of comets
   a. Open
   b. Closed
3. Physical nature
   a. Size
   b. Mass
   c. The tail

B. Meteors
1. Fireballs
2. Showers
3. Masses
4. Ages
5. Distribution
6. Craters

VII. Cosmology

A. Evidence
1. Expanding universe
2. Red shifts

B. Cosmological models
1. Evolutionary
2. Steady state
3. Big bang

PART II. RESOURCES

A. Texts

Exploration of the Universe, Abell, George, Holt, Rinehart and Winston, New York, N.Y., 1919.

The Sun and It's Family, Adler, Irving, New American Library, New York, N.Y., 1958.

The Universe at Large, Bondi, Herman, Doubleday and Co., Garden City, New York, N.Y., 1960.

A Brief History of Science, Hall, Rupert and Marie, New American Library, New York, N.Y., 1964.

B. Teaching Styles

The course is designed to motivate the student toward developing a curiosity concerning the universe so that he will do independent study on his own. Class size is limited to allow for student-student and teacher-student discussion. Factual material in lecture form is presented by the teacher, and in-class problems are raised which the students are asked to solve. Trips to planetariums are encouraged.

C. Student Parameters

Students are expected to attend classes regularly. They are also encouraged to read current material and follow star positons, and are required to spend a period of time looking through a telescope. Algebra I is a prerequisite.

D. Evaluation
Individual conferences are held with each student at the beginning of the course and criteria are established. Final evaluation is made in conference with each student according to these criteria.

E. Modular Configuration
This course meets eight mods per week in a 3-3-2 pattern for two facets.

PART III. DETAILED UNIT MODELS

Introduction

Basic to the working of science is the concept of model making. This first lesson does the following:

1. Gives an example of model making
2. Provides the student with some background in atomic theory
3. Introduces the astronomy course

Detailed Outline

I. The Model

A. Nature
   1. Explanation of observed phenomena
   2. Consistency
   3. Simplicity
   4. Modifications
   5. Rejections

B. Developers of the atom model
   1. The Greek Meta physicians
      a. Formulated for philosophical reasons
      b. Smallest "piece" of matter
      c. Indivisible
   2. J.J. Thomson
      a. Discovery of the electron
         1) Smaller than the atom
         2) Result: rejection of Greek "atom" model
      b. Building of a new model: "Thompson's Pudding"
         1) Positive change
         2) Amorphous mass
         3) Electron's placement
         4) "Raisins in a pudding"
   3. Rutherford
      a. The hard core in center of atom
      b. Nuclear atom
      c. Planetary electrons
   4. Bohr
      a. The hydrogen spectrum
      b. Energy levels
      c. Chemical bonds
   5. Heisenburg
      a. Probability
      b. Uncertainty principle
      c. Electron cloud
   6. Quantum mechanics

II. Models of the Universe

A. Explanations of phenomena
   1. Darkness and light
   2. Motions of the sun and moon
   3. Tides
   4. Winter and summer
   5. Fixed and wandering stars
   6. Colors of stars
   7. Phases of the moon

B. Contemporary models
   1. Geocentric
   2. Heliocentric
   3. Relativistic

FOSSILS AS A KEY TO THE PAST

by Robert C. Young

OBJECTIVES

The major objectives of this course are:

1. To understand the processes which preserve evidence of living things
2. To become familiar with the variety of living things which have inhabited the earth in its past
3. To develop an appreciation of the evolution of life on the earth
4. To learn basic climate conditions which exist in various parts of the earth today
5. To apply the concept of uniformitarianism in attempting to describe ancient environments by relating them to the life in the earth's past
6. To attempt to predict the evolutionary trends of present day life forms

PART I. COURSE OUTLINE

I. Introduction and Overview

II. Changes in Living Things

A. What is life: characteristics of living organisms

B. How life began
   1. Biological considerations
   2. Early atmosphere as a determinant of life

C. Diversification of life
   1. Natural selection and Darwin
   2. Genetics
   3. Evolution and the fossil record
      a. Radiation
      b. Parallelism

III. Fossilization: Processes and Interpretations

A. Definition

B. Formation
   1. Preservation of entire organism
   2. Unaltered hard parts

3. Preservation of carbon residue
4. Replacement and petrifaction
5. Casts and molds
6. Indirect evidence

C. Significance
1. Evidence of evolutionary change
2. Place in the food system on earth
3. Proof of adaptation
4. Evidence of migration

IV. Geologic Time of the Earth

A. Division of earth history
1. Evidence for divisions
2. History of how divisions were determined

B. General events
1. Areas of deposition
a. Types of materials
b. Significance to formation of fossils
2. Periods of earth deterioration
3. Periods of earth build-up

C. Use of life events to divide earth history

V. Geologic Environments

A. Physical interpretation of rock types
1. Igneous
2. Sedimentary
3. Metamorphic

B. Ecology and paleoecology
1. Adaptive responses of organisms
a. Range of reaction
b. Habitats
c. Niches
d. Adaptive morphology
2. Functional morphology
a. Appendages and locomotion
b. Mammalian teeth

C. Factors of environment
1. Temperature
2. Oxygen and carbon dioxide
3. Sunlight
4. Salinity
5. Water turbulence
6. Nature of the substrate

D. Patterns of life in the sea
1. Plankton
2. Nekton
3. Benthos
4. Filter-feeders
5. Sediment feeders
6. Herbivores
7. Carnivores and scavengers

VI. Fossils as Keys to the Past

A. Principle of uniformitarianism
B. Principle of superposition
C. Principle of faunal succession
D. Principle of biotic association

VII. Life in the Sea

A. Marine plants
B. Marine invertebrates
1. Protozoans and sponges
2. Coral
3. Echinoderms
4. Mollusks
5. Branchiopods
6. Trilobites
7. Bryozoans
8. Arthropods

C. Invertebrate radiations and extinctions
1. Causes
2. Effects

VIII. The Transition of Life to the Land

A. Plant transitions
1. Changes necessary
2 Types of early plant life

B. Terrestrial invertebrates
1. Gastropods
2. Arthropods

C. Origin of the vertebrates
1. Invertebrate chordates
a. Lancelets
b. Tunicates
c. Acorn worms
2. Development of the notochord

D. Evolutionary history of fishes
1. Agnaths
2. Placoderms
3. Sharks and bony fishes

E. Amphibians, the transitional vertebrates
1. Lobe-finned vs. ray-finned fishes
2. Lungfish
3. Crossopterygians
4. Labrinthodonts

IX. Land Plants

A. Seedless floras of the Paleozoic era
1. Reproduction
2. Types
a. Psilopsids
b. Lycopsids
c. Sphenosids
d. Pteropsids

B. Early seed-bearing plants
1. Reproduction
2. Types
a. Seed ferns
b. Cycads and ginkgoes
c. Conifers

C. Flowering plants
1. Rise and dominance
2. Diversity
3. Origin

X. Reptiles and Mammals

A. Early reptiles
   1. Cotylosaurs and mammal-like reptiles
   2. Turtles, lizards and snakes
   3. Marine reptiles

B. Rise of reptiles to dominance
   1. Thecodonts
   2. Birds
   3. Pterosaurs and crocodiles
   4. Dinosaurs
      a. Ornithopods
      b. Stegpsairs and ankylosaurs
      c. Horned dinosaurs
      d. Sauropods
      e. Carnivores

C. Mammal origins and diversification
   1. Early mammals
   2. Monotremes
   3. Marsupials
   4. Placentals

XI. Man

A. Primate origins and adaptations
   1. Prosimians
   2. Early monkeys and apes

B. Pleistocene expansion of man
   1. Ramapithecus
   2. Australopithecus
   3. Homo erectus
   4. Homo sapiens

XII. Recreating Ancient Environments Through Application of Fossil Evidence

A. The Devonian fossil biotherm

B. The Pennsylvanian plant swamp

C. The Miocene coastal plain

PART II. RESOURCES AND EVALUATION

A. Texts

Ancient Environments, Laporte, Leo F., Prentice-Hall, Inc., Englewood Cliffs, N.J., 1968

The History of Life, MacAlester, A. Lee, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1968.

Introduction to Geology, Stokes, William L. and Judson, Sheldon, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1968.

B. Additional Readings

The Age of Dinosaurs in Northern Arizona, Breed, William J., Museum of Northern Arizona, Flagstaff, Arizona, 1968.

Fossils for Amateurs, MacFall, Russell P. and Wollin, Jay C., VanNostrand Reinhold Co., New York, N.Y., 1972.

Fossils in Color, Kirkaldy, J.F., Hippocrene Books, Inc., New York, N.Y., 1972.

Fossils of New Jersey, Yolton, James S., Geological Survey of N.J., printed by MacCrellish & Quigley Co., Trenton, N.J., 1965.

Miocene Fossils of Maryland, Vokes, Harold E., Bulletin 20 Maryland Geological Survey, Baltimore, Maryland, 1957.

The Origin and Evolution of Coal, Adams, P.J., Her Majesty's Stationery Office, London, England, 1960.

Tales Told by Fossils, Fenton, Carroll L., Doubleday and Co., Inc., Garden City, N.Y., 1966.

C. Periodicals

1. Listed in the Readers' Guide to Periodical Literature
   Science
   Science News
   Scientific American
2. Not listed in the Readers' Guide
   Journal of Geological Education
   Fossils
   Ward's Bulletin

D. Films

A number of films are available from various agencies including the two listed below from Shell Oil Company.

A Fossil Story
Story in the Rocks

E. Filmstrips

Most science supply companies have numerous filmstrips available on the subject of fossils.

An Introduction to Fossils-
Ward's Earth Science Series
Nature of Fossils
Fossils-Key to the Past
Life of the Lower Paleozoic
Life of the Upper Paleozoic
Life of the Mesozoic
Life of the Cenozoic

F. Field Trips

Trips should be made to areas where fossils may be collected.

G. Supplementary Laboratory Materials

Fossil Deck, Shourd, Melvin L., Colorado Geological Industries, Denver, Colorado, 1965.

Stereogram Book of Fossils, Sandberg, Philip A., Hubbard Scientific Co., Northbrook, Illinois.

H. Teaching Styles

The students are expected to attend all classes. Most material in class is presented in small group discussions. One important field trip is taken, and considerable laboratory work using fossil collections is provided by the instructor. Students try to form their own collections from this field trip.

I. Student Parameters

Students spend considerable time working in small groups with the instructor. They are encouraged to

develop their own collections. The laboratory is open to the students during their free mods for extra work. Biology is a prerequisite.

J. Evaluation

Tests are given to determine ability to apply principles to theoretical problems. Ten laboratory exercises are completed during the two facets. Students completing the course should be able to discuss related geological problems, and to apply the material covered to other related scientific areas.

K. Modular Configuration

The class meets for seven mods per week on a 3-2-2 basis, for two facets.

PART III. DETAILED UNIT

Fossilization: Processes and Interpretation

Introduction

General discussion of the question "What is a fossil?"

Objectives of this unit are:

1. To show that a fossil can be any evidence of something that was once living
2. To show that fossils can give us clues to past environments and biotic associations
3. To show that fossils may give us clues as to how the organism died

I. Definition of a Fossil

II. Formation of Fossils

- A. Preservation of entire organism
  - 1. Tar pit victims
  - 2. Frozen carcasses
  - 3. Shells, bones, teeth
- B. Unaltered hard parts: shells, bones, teeth
- C. Preservation of carbon residue
  - 1. Leaves
  - 2. Fish scales and carbons
- D. Replacement and petrifaction
  - 1. Petrified wood
  - 2. Pyritization of shells
- E. Casts and molds
- F. Indirect evidence of fossils
  - 1. Footprints
  - 2. Coprolites
  - 3. Castroliths

III. Significance of Fossils

- A. Evidence of evolutionary change
  - 1. Morphologic change in trilobites
  - 2. Morphologic change in cephalopods
- B. Place in the food system on earth
  - 1. Feeding habits
  - 2. Animals as food source
  - 3. The chain of life
- C. Proof of adaptation
  - 1. Changes in response to climate
  - 2. Changes in response to other stimuli
- D. Evidence of migration
  - 1. Extent and range of fossil organisms
  - 2. Isolationism and natural barriers

GENETICS

by Newton Beron

OBJECTIVES

This course is designed to supplement and expand upon the unit on heredity normally studied in General Biology. Originally intended as a seven week program (one facet), it has been expanded to fourteen weeks in order to review basic concepts, current literature, and some of the more practical applications of the science.

A branch of biology, genetics, attempts to explain the similarities and differences which exist between living things related by descent. It is linked to chemistry, mathematics, and physics; thus these relationships are considered.

PART I. COURSE OUTLINE

I. Introduction

- A. Historical considerations
  - 1. Greek philosophers and their theories
  - 2. Seventeenth and eighteenth century scientists
    - a. William Harvey
    - b. Leeuwenhoek
    - c. Swammerdam and preformation
    - d. Graff and the mammalian eggs
    - e. Maupertius
    - f. Bonnet and encasement
    - g. Wolff and epigenesis
  - 3. Nineteenth century genetics
    - a. Lamarck's "use and disuse"
    - b. Lysenko's plantwork
    - c. Darwin and natural selection
    - d. Weismann and the germ plasm theory
    - e. DeVries and mutations
    - f. Mendel and his breeding experiments
  - 4. Twentieth century investigation
    - a. Johannsen's pure line concept
    - b. Bateson and Punnett on linkage
    - c. Wilson and cytogenetics
    - d. Morgan and the fruit fly
- B. The cell
  - 1. Basic structure
  - 2. Chromosomes and genes
  - 3. Mitosis and meiosis
  - 4. Spermatogenesis and oogenesis
  - 5. Fertilization

II. Genetic Crosses

- A. Mendel's monohybrid crosses
  - 1. Dominance and recessiveness
  - 2. Genetic ratios

3. Genetic shorthand - symbols
4. Genetic vocabulary - homozygous and heterozygous; genotype and phenotype; *alleles*
5. Diagramming crosses

B. The test cross

C. Genes with intermediate expression
1. Absence of dominance
2. Genotype determination
3. Incomplete dominance

D. Lethal genes
1. Frequency of expression
2. Intermediate lethals

E. The dihybrid cross
1. Independent segregation
2. The Punnett Square

F. Problem solving

III. Sex Determination

A. X and Y chromosomes - the Drosophila

B. Hormones and sex determination

C. Problem solving

D. Sex-linkage
1. Hemophilia
2. Color-blindness

E. Sex-influenced genes in man and other animals

F. Typical problems

IV. Genetics and Blood Groups

A. History and blood groups

B. Blood antigens and antibodies

C. Blood typing and transfusion

D. Inheritance

E. The MN antigens

F. Rh factor

V. Linkage

A. Discovery

B. Crossing-over

C. Interference and coincidence

D. Problem solving

VI. Genetic Chemistry

A. Chromosome composition--DNA

B. Virus studies

C. RNA

VII. Genetic Mutations

The outline presented above serves as a review of some of the basic concepts of genetics, and is completed during the first facet (seven weeks). The second seven week period is devoted to independent readings. Each student is required to investigate the literature, magazines, periodicals and texts, and submit a written summary of one reading for each of the topics listed below.

Students are asked to comment on the readings each week so that the entire class may derive benefits from all of the independent work. In addition, the instructor and/or class members invite guest speakers to make presentations on areas related to these topics.

TOPICS FOR INDEPENDENT STUDY

I. Sex Linkage

II. Radiation and Genetics

III. Plant Propagation

IV. Animal Husbandry

V. Pathology, Cancer and Blood

VI. Genetics and Mental Illness

VII. Genetics and the Environment

PART II. RESOURCES AND EVALUATION

A. Texts

Heredity, An Introduction to Genetics, Second Edition, Winchester, A.M., Barnes and Noble Books, A Division of Harper and Row, New York, N.Y., 1972.

The Challenge of Genetics, Simon, Edward H., and Grossfield, Joseph, Addison-Wesley Publishing Co., Reading, Mass., etc., 1971.

The Evolution of Genetics, Ravin, Arnold W., Academic Press Inc., New York, N.Y., 1968.

Chromosomes, Giant Molecules, and Evolution, Wallace, Bruce, W.W. Norton and Co., New York, N.Y., 1966.

Genetics and Man, Darlington, C.D., Schocken Books, New York, N.Y., 1969.

New Patterns in Genetics and Development, Waddington, C.H., Columbia University Press, New York and London, 1966.

B. Periodicals

Readings may be from magazines such as "Time," "Scientific American," "Newsweek," "Science Digest," or any publication containing articles pertinent to the subjects under consideration.

C. Field Trips

Visits may be scheduled to local establishments such as hospitals, animal breeding farms, greenhouses, blood banks, etc. in lieu of obtaining the services of speakers.

D. Teaching Styles

Some of the course is taught in command style, teacher dominated; problem solving is done at the blackboard; and informal discussions are held regarding independent readings.

E. Student Parameters

Students are expected to read extensively and attend class regularly. No credit is awarded to students who miss more than three class meetings.

F. Evaluation

Two quizzes are given at the end of each facet. Grades are given, based on the results of these tests and the subjective evaluation of the teacher (in conjunction with each student) regarding class participation, readings, etc. Students may request Pass-Fail.

G. Modular Configuration

The course meets five mods per week for two facets on a 3-2 basis.

PART III. DETAILED UNIT

GENETICS AND BLOOD GROUPS

I. History
- A. Karl Landsteiner's discoveries
- B. Plasma and agglutination
- C. The four blood groups

II. Antigens and Antibodies
- A. Characteristics of antigens
- B. Antigens give rise to antibodies
- C. Specificity of antibodies

III. A and B Antigens and Antibodies
- A. Presence of A or B or neither
- B. Presence of A antigen causes B reaction
- C. Presence of B antigen causes A reaction
- D. Lacking A or B antigens (Type 0) carries anti-A and Anti-B
- E. Presence of A and B - no antibodies

IV. Blood Transfusions
- A. Agglutination problems
- B. Donors and recipients

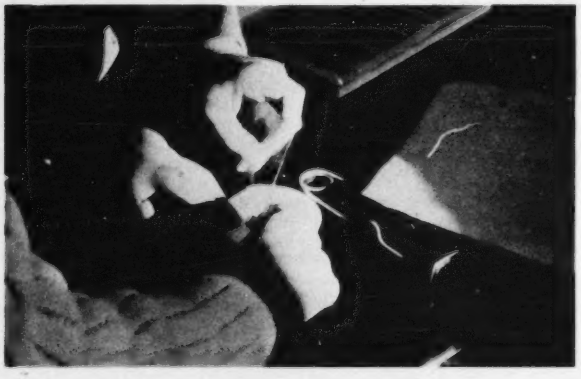
V. Blood Typing - Sera A or B

VI. Inheritance of A, B or O Groups
- A. Multiple alleles and location of genes
- B. The gene for producing A antigens
- C. The gene for producing B antigens
- D. Heterozygous production of A - B
- E. Lack of A or B - Type O (Homozygosity)
- F. Medical and legal applications of blood group inheritance

VII. The MN Factors
- A. M or N factor found in all humans
- B. Heterozygous condition possible - hence MN
- C. No difficulties in transfusions

VIII. Rh Factor
- A. Rhesus monkey experiments
- B. Rh factor identified
- C. Transfusions
- D. Maternal-fetal incompatability
- E. Inheritance

IX. Problem Solving



INTRODUCTION TO ENTOMOLOGY

by James E. Parker

OBJECTIVES

The objectives of this course are: to allay students' fear of insects by familiarizing them with their structures and habits; to provide a background in entomology which will stimulate further investigation into the field; and, to provide a working knowledge of entomology to enable students to pursue the field at the college level.

Other objectives are; to teach students basic collection and microdissection techniques; to acquaint students with beneficial as well as harmful insects; to teach students how to identify insects using a dichotomous key; and, to develop an understanding which will enable students to decide how they wish to live with insects.

Students will fulfill these objectives through a series of laboratory experiences and classroom discussions.

PART I. COURSE OUTLINE

I. Introduction and Overview
- A. What is entomology?
- B. What is the work of an entomologist?
  1. Collecting insects
     - a. Live study
     - b. Preserved
  2. Studying insects in field

II. What is an Insect?
- A. Definition
- B. General body plan
  1. Head
  2. Thorax
     - a. Six legs
     - b. One or two pair of wings
  3. Abdomen

III. How to Collect Insects
- A. Insect net
- B. Hand collecting
- C. Night collecting
- D. Pinning
- E. Insect cages

IV. How to Study Insects
- A. Living
  1. In lab
  2. In nature
- B. Preserved

V. Importance of Insects to Man
- A. Study
  1. Effects of radiation
  2. Structure
  3. Life cycle

B. Agricultural
   1. Helpful
   2. Harmful
C. Medical
   1. Helpful
   2. Harmful
D. Historical
E. Economical
   1. Lac beetles
   2. Silk worms
   3. Honey bees
F. Pigments
G. Food

VI. Evolution of Insects

A. Origin
B. Adaptation to environment
C. Future prospects

VII. Classification of Insects

A. Basis
B. Groups

VIII. Morphology of Insects

A. Head
   1. General function
   2. External morphology
      a. Mouth
      b. Eyes
      c. Antennae
   3. Internal morphology
      a. Supporting structures
      b. Muscles
      c. Brain and nervous system
   4. Variations on the general theme
B. Thorax
   1. External
      a. Wings
      b. Spiracles
      c. Legs
   2. Internal
      a. Heart
      b. Digestive system
      c. Respiratory system
      d. Glands
      e. Supporting structures
      f. Muscles
   3. Variations on the general theme
C. Abdomen
   1. External
      a. Spiracles
      b. Reproductive structures
      c. Appendages
      d. Tympana
   2. Internal
      a. Supporting structures
      b. Muscles
      c. Systems

IX. Physiology of Insects

A. Respiratory system
   1. Review of morphology
   2. Variations in form and function
   3. Gas exchange
B. Circulatory system
   1. Review of morphology
   2. Blood chemistry
   3. Mechanics of circulation
C. Digestive system
   1. Review of morphology
   2. Secretions
   3. Mechanics of digestion
   4. Functional variations
D. Nervous system
   1. Review of morphology
   2. Neural pathways
   3. Neural secretions
   4. Receptors
   5. Effectors
   6. Mechanics of response mechanisms
E. Excretory system
   1. Reveiw of morphology
   2. Chemistry of wastes
   3. Mechanics of excretion
F. Muscle system
   1. Review of morphology
      a. Origin
      b. Insertion
   2. Micro-morphology
   3. Contraction mechanisms

X. Defense Mechanisms of Insects

A. Structural
   1. Mouth parts
   2. Abdominal appendages
   3. Mimicry
B. Chemical
   1. Repellents
   2. Toxins
   3. Taste

XI. Insects' Role in the Biosphere

A. Decomposer
B. Parasite
C. Disease vector
D. Competitor with man

PART II. RESOURCES AND EVALUATION

A. Texts

Principles of Insect Morphology, Snodgrass, R.E., McGraw-Hill Book Co., New York, N.Y., 1935.

The World of Insects, Dempsey, Michael W., B.P.C. Publishing Co., England, 1968.

B. Additional Readings

Applied Entomology, Fernald, H.T. and Shepard, Harold H., McGraw-Hill Book Co., New York, N.Y., 1955.

Atlas of Insects, Tweedie, Michael, The John Day Co., New York, N.Y., 1974.

Biological Techniques, Knudsen, Jens W., Harper and Row, New York, N.Y., 1966.

Butterflies and Moths, Mitchell, Robert T., and Zim, Herbert S., Golden Press, New York, N.Y., 1964.

Communication Among Social Bees, Lindauer, Martin, Harvard University Press, Cambridge Mass., 1967.

Familiar Insects of America, Barker, Will, Harper and Row, New York, N.Y., 1960.

A Field Guide to the Insects of America North of Mexico, Borror, Donald J. and White, Richard E., Houghton Mifflin Co., Boston, Mass., 1970.

Insects, Hutchins, Ross E., Prentice-Hall, Englewood Cliffs, N.J., 1966.

The Insects, Farb, Peter, Time Inc., New York, N.Y., 1962.

An Introduction to the Study of Insects, Borror, Donald J. and Delong, Dwight M., Holt, Rinehart and Winston, New York, N.Y., 1971.

Man and Insects, Newman, L.H., The Natural History Press, Garden City, N.Y., 1966.

101 Simple Experiments with Insects, Kalmus, H. Doubleday and Co., Garden City, N.Y., 1958.

1001 Questions Answered About Insects, Klots, Alexander B. and Klots, Elsie B., Dodd, Mead and Co., New York, N.Y., 1961.

The Strange Lives of Familiar Insects, Teale, Edwin Way, Dodd, Mead and Co., New York, N.Y., 1961.

C. Periodicals

1. Listed in the Reader's Guide to Periodical Literature
   - Audubon
   - Natural Geographic Magazine
   - Natural History
   - Science
   - Science American
   - Smithsonian
2. Periodicals not listed in Reader's Guide
   - American Biology Teacher

D. Films

Films are available from a variety of sources. The ones listed below are excellent supplements to the course:

Encyclopaedia Britannica Educational Corp., Chicago, Illinois
- *Army Ants: A Study in Social Behavior*
- *Insect Parasitism*
- *Insects*
- *Social Insects - Honey Bee*

McGraw Hill Films, Hightstown, New Jersey
- *Life Cycle of the Mosquito*
- *The Winners*

Moody Institute of Science, Palo Alto, California
- *Cicada - Insect Methuselah*

Films, Inc., Chicago, Illinois
- *Hidden World - Study of Insects*

B.F.A. Educational Media, Santa Monica, California
- *Insect Foods*

Stanton Films, Beverly Hills, California
- *Adaptation of Insects*

E. Consultants, Outside Speakers and Trips

Potential sources are County Agriculture Extension Services, various museums of natural history, local individuals and hobbyists.

F. Teaching Styles

The lecture method is used to introduce students to basic concepts. Collection of insects is followed by numerous laboratory sessions. Field work is done in groups and each student is encouraged to work on his own time. Several films are shown.

G. Student Parameters

All students are required to attend class and participate in the numerous field trips. A student collection is required. Each person is expected to participate in small group discussions.

H. Evaluation

Student progress in attitudinal objectives will be made by observing overt behavior and through pre and post testing. Other evaluation instruments are built into the course in the form of laboratory reports, small projects and tests. Final evaluation will be made through individual student-teacher conferences during which progress will be reviewed and evaluated.

I. Modular Configuration

The class meets for seven mods per week in a 2-2-3 pattern for two facets.

PART III. DETAILED UNIT

MORPHOLOGY OF INSECTS

Introduction

In order to accomplish the purposes of this course, the following areas of investigation must be covered: the structure of insects, the function of insects, insects as a hobby, insects as friends, and insects as enemies. The topic of insect structure is detailed below:

I. Morphology of the Head

- A. General function - sensory
- B. External features
  1. Mouth
     - a. Mandible
     - b. Maxilla
     - c. Palpus
     - d. Labrum
     - e. Hypopharynx

2. Eyes
   a. Compound
   b. Simple (ocelli)
3. Antennae
   a. Clublike
   b. Feathe[illegible]e
   c. Segmented
   d. Thread-like

C. Internal morphology
1. Supporting structures
   a. Tentorium
   b. Extensions of exoskeleton
2. Muscles
   a. Names
   b. Points of attachment
      (1) Origin
      (2) Insertion
   c. Brain

D. Variations on the theme
1. Honey bee - Apis - sucking mouth
2. House Fly - sponging
3. Horse Fly - slashing
4. Mosquito - piercing and sucking
5. Grasshopper - chewing
6. Dragonfly nymph - grasping and chewing

II. Morphology of the Thorax

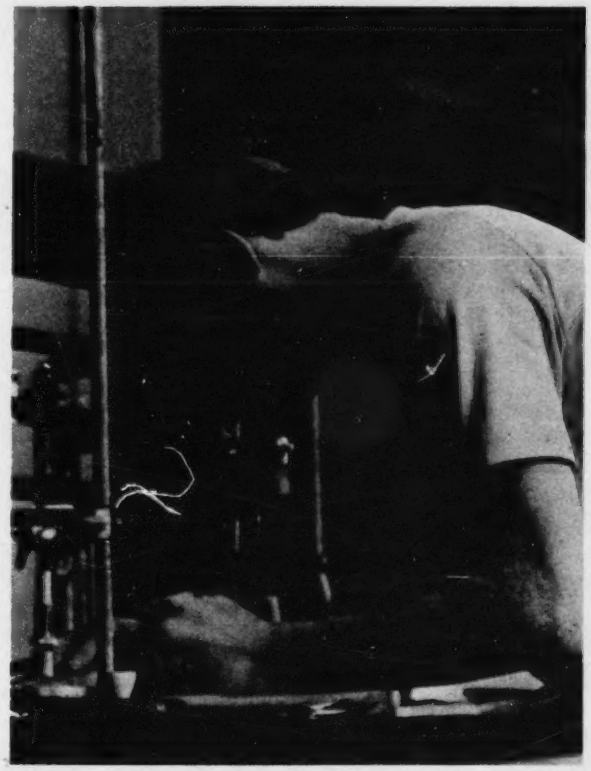
A. External
1. Wings
   a. Two wings and two halteres
   b. Two pair of wings
2. Spiracles
3. Legs
   a. Jumping
   b. Pollen baskets
   c. Paddles
4. Feet
   a. Claws
   b. Suction pads
   c. Water striders

B. Internal
1. Heart
2. Digestive tract
   a. Hematophagus
   b. Herbivores
   c. Carnivores
   d. Nectar eaters
   e. Termites
3. Respiratory system
   a. Terrestrial
   b. Aquatic
4. Glands
   a. Salivary
   b. Reproductive
   c. Digestive
5. Supporting structures
6. Muscles

III. Morphology of the Abdomen

A. External
1. Spiracles
2. Reproductive structures
   a. Male
   b. Female
   c. Specialized modifications
3. Appendages
   a. Respiratory tubes
   b. Jumping devices - springtails
4. Tympana

B. Internal
1. Supporting structures
   a. Exoskeleton
   b. Turgor
2. Muscles
3. Digestive system
4. Respiratory system
   a. Terrestrial
   b. Aquatic
5. Circulatory system
6. Excretory system
   a. Solid
   b. Liquid
7. Reproductive system
   a. Male
   b. Female
8. Nervous system
9. Endocrine system



A SHORT COURSE IN LABORATORY TECHNOLOGY

by Robert J. Lees

OBJECTIVES

The major objective of this course is to provide students with an opportunity to explore the field of laboratory technology. This is accomplished by observing laboratory personnel in several areas of technology and conducting basic laboratory procedures similar to those observed. Through field trips, the students can obtain a more comprehensive understanding of the work of laboratory assistants, technicians, technologists and other laboratory workers. Through actual tests and laboratory procedures, students simulate laboratory conditions and activities. Students then can evaluate a future in the various fields of laboratory technology.

In addition, students provided with the basic knowledge and skills necessary to work with laboratory equipment and materials, are able to perform in future laboratory situations. They thus secure an above-average competency at avocational, college and career levels. Students also have opportunities to pursue, in depth, specific areas of laboratory technology or interest, such as, medical, veterinary, industrial or agricultural.

PART I. COURSE OUTLINE

I. Introduction

- A. Opportunities and occupations in laboratory technology
- B. Practical aspects of a course in laboratory technology
- C. Standards of behavior and safety factors used in the laboratory

II. Basic Laboratory Procedures and Skills

- A. Metric system
  1. Review of units
  2. Development of skills
- B. Basic chemical information
  1. Chemical symbols and formulas
  2. Elements, mixtures and compounds
  3. Acids, bases and salts
  4. Indicators and pH scales
  5. Preparation of solutions
  6. Use of stains, dyes and indicators
  7. Storage and disposal of solutions, acids and bases
  8. Safety precautions in the handling of acids, bases and solutions
- C. Laboratory equipment and materials
  1. Care and use of glassware
  2. Use of the bunsen burner
  3. Operation and use of the centrifuge
  4. Operation and use of the autoclave
  5. Use of the standard laboratory microscope
  6. Operation and use of the pH meter
  7. Use of the incubator and environmental control chamber
  8. Computer-analysis equipment theory
  9. Spectrometry-analysis theory
- D. Scientific procedures
  1. Experimental method and design
  2. Experimental procedure organization
  3. Observation techniques
  4. Data organization and recording
     a. Graphs
     b. Tables
     c. Charts
     d. Standard forms
     e. Basic computations
  5. The importance of following directions
  6. Safety factors
  7. Procedural analysis

III. Individual Testing Procedures and Skill Development

- A. Medical technology
  1. Urinalysis procedures
     a. Acetoacetic acid
     b. Bilirubin
     c. Glucose
     d. Magnesium
     e. Phenylpyruvic acid
     f. Microscopic analysis
  2. Hematology procedures
     a. Rh factor
     b. Blood typing
     c. Blood smears
     d. Sickle Cell Anemia
     e. Blood counts
  3. Serum analysis
     a. Calcium
     b. Salicylate
     c. Magnesium
  4. Pregnancy tests
  5. Parasitological techniques
  6. Pathological techniques
- B. Veterinary technology
  1. Care and feeding of animals
  2. Urinalysis procedures
     a. Glucose
     b. Microscopic analysis
  3. Feces analysis
  4. Blood testing
- C. Biological technology
  1. Bacteriological techniques
     a. Preparation of culture media
     b. Specimen collection
     c. Preparation of microscopic smears
     d. Observation and identification of smears
     e. Safety precautions and clean-up
  2. Mycological techniques
     a. Preparation of culture media

b. Specimen collection
c. Observation and identification
d. Safety precautions and clean-up
3. Radioactive tracers

D. Industrial technology
1. Pharmaceutical techniques
a. Disc tests of antiseptics and antibiotics
b. Raising and caring for laboratory animals
2. Chemical techniques
a. Dyes and dying
b. Analysis of dyes
d. Soap-making
d. Comparative testing of soaps and detergents
3. Metallurgical techniques
a. Flame tests
b. Borax bead tests
c. Cobalt nitrate tests
4. Pollution control
a. Air pollution tests
b. Water pollution tests

E. Agricultural technology
1. Soil testing procedures
a. NPK analysis
b. pH
2. Soil classification
3. Plant pathological techniques
4. Animal pathological techniques

PART II. RESOURCES AND EVALUATION

A. Texts

In lieu of a suitable textbook for the course, information sheets and exercises prepared by the instructor are provided to the students.

B. Additional Readings

The following is presented as a representative listing. Texts indicated with an asterisk (*) are excellent sources for hand-out sheets and exercises.

Clinical Chemistry: Principles and Procedures, Annio, J.S., Little, Brown and Co., Boston, Mass., 1964.

Manual of Histologic and Special Staining Techniques, Armed Forces Institute of Pathology, Washington, D.C., 1957.

Veterinary Medicine, USDA Yearbook, 1956, U.S. Government Printing Office, Washington, D.C., 1956.

World of Carbon, Asimov, Isaac, Abelard-Schuman, New York, N.Y., 1958.

*Veterinary Medicine, Catcott, Earl J., ed., American Veterinary Publications, Wheaton, Ill., 1971.

The Encyclopedia of Chemistry, Clark, George, (ed.), Reinhold, New York, N.Y., 1966.

**Laboratory Techniques in Chemistry and Biochemistry*, Diamond, Paul S., John Wiley and Sons, New York, N.Y., 1973.

**The Care and Breeding of Laboratory Animals*, Farris, Edmond J., John Wiley and Sons, New York, N.Y., 1950.

**Manual of Clinical Laboratory Procedures*, Faulkner, Willard R., King, John, (eds.), The Chemical Rubber Co., Cleveland, Ohio, 1970.

Practical Physiological Chemistry, Hawk, P.B., Oser, B.L., and Summerson, W.H., The Blakiston Co., New York, N.Y., 1954.

**Laboratory Identification of Pathogenic Fungi, Simplified*, Hazen, Elizabeth Lee, Thomas, Charles C., Springfield, Ill., 1970.

**Manual of Clinical Laboratory Methods*, Hepler, O.E., Thomas, Charles C., Springfield, Ill., 1965.

**The Encyclopedia of Careers and Vocational Guidance*, Hopke, William E., (ed.), Doubleday and Co., Chicago, Ill., 1972.

**Medical Laboratory Technology and Clinical Pathology*, Lynch, M.J., Raphael, S.S., Meller, L.D., Spore, P.D., and Inwood, M.J.H., Saunders, W.B., Philadelphia, Penna., 1969.

Pathological Techniques, Mallory, F.B., and Saunders, W.B., Philadelphia, Pa., 1942.

Standard Methods of Clinical Chemistry, Meites, S., (ed.), Academic Press, New York, N.Y., 1961.

**Laboratory Animals*, Silvan, James, Natural History Press, New York, N.Y., 1966.

First Aid and Care of Small Animals, Walker, E.P., Animal Welfare Institute, New York, N.Y., 1955.

**Plant Pathology*, Walker, John C., McGraw Hill Book Co., New York, N.Y., 1957.

**Chemistry: A Lab Science by the Semimicro Method*, Weisbruch, Fred T., D.C. Heath and Co., Lexington, Mass., 1966.

C. Careers and Occupational File

Career centers and libraries with career and occupational files may be used for reference by the students and instructor. In addition, career information can be obtained from various schools and colleges.

D. Films

A number of films are available on careers in laboratory technology as well as for specific units. Possible sources include *Educators' Guide to Free Films*.

E. Supplies, Equipment and Materials of Instruction

Most of the supplies, equipment and materials for this course can be found in the catalogs of the following companies: Ames, Carolina Biological Supply, Sargent-Welch, and Stansi. Additional sources for the medical and veterinary supplies can be obtained from local hospital personnel, doctors and veterinarians.

F. Consultants, Outside Speakers and Field Trips

Laboratory technologists in local hospitals, veterinarians, foremen of industrial laboratories and chemistry teachers are all possible consultants for this course. Field trips, an integral part of the course, include the following:

Veterinary Hospital or Clinic, Medical Laboratory, Hospital Laboratory, Pharmaceutical Laboratory, Industrial-Chemical Laboratory, Environmental Protection Agency Laboratory and various departmental laboratories at a College of Agriculture.

G. Teaching Styles

Students are required to follow instructions carefully. Each exercise is followed by discussion, in small groups, regarding the results. The field trips to nearby facilities demonstrate the practical usage of various techniques learned in the school laboratory.

H. Student Parameters

Considerable emphasis is placed on individual student work and experimentation. Class periods are used for discussions and planning. There are numerous field trips. Students are expected to make up the work missed from other classes. Biology and chemistry are prerequisites.

I. Evaluation

The types of evaluation are generally dependent upon the teaching styles used to present the course material. Laboratory skills and field trip observations are graded with classroom quizzes and tests. The instructor should always keep in mind that the course is designed as an exploration of the various fields of laboratory technology and that students are not expected to become experts in any or all of the areas covered.

J. Modular Configuration

The class meets for eight mods in a 3-3-2 pattern for two facets.

PART III. DETAILED UNIT

THE METRIC SYSTEM

Introduction

A thorough understanding of the metric system is essential to work in the fields of laboratory technology. Therefore, students who enroll in this course need working knowledge of this system. For some students, this unit serves as a review; for others, the unit is a total learning situation.

I. Value and Importance of the Metric System

- A. History of development
- B. World usage
- C. Status in U.S.A.
- D. Technological and scientific usage

II. Structure of the Metric System

- A. Decimal system
- B. Prefixes
- C. Scientific notation
- D. Length units
- E. Volume units

III. Skill Development

- A. Volume units
  1. Volume determining instruments
  2. Determining volumes of various laboratory substances
- B. Mass units
  1. Mass determining instruments
  2. Determining masses of various laboratory substances
- C. Linear units
  1. Linear determining instruments
  2. Determining the lengths and widths of various laboratory substances
- D. Microscopic measurement
  1. Units in common usage
  2. Determining magnification of various laboratory substances
- E. Density determination
  1. Formula for density
  2. Determining the density of various laboratory substances

IV. Practical Application

- A. Preparation of Benedict solution
- B. Preparation of Sulkowitch's reagent
- C. Preparation of 10% NaOH solution

PART IV. RESOURCES

Unit on Metric System

Almost all science books contain information and units on the metric system. The following two books are particularly useful:

Think Metric, Branley, F.M., Crowell, New York, N.Y., 1972.

Prepare Now for a Metric Future, Donovan, Frank, Weybright and Talley, New York, N.Y., 1970.

MARINE ECOLOGY

by James E. Parker

OBJECTIVES

The objectives of this course are to familiarize students with the basic ecological principles operating in the marine ecosystem (particularly as applied to local marine settings) and to impress upon them the need for maintaining a suitably clean marine environment. Students are introduced to the various pressure groups through which they can work to conserve our marine resources, and to the various industries which can, and will, become major influences on our marine environment.

Other course objectives include helping students become reasonably proficient in the construction and use of marine sampling and testing devices, using a dichotomous key to identify local marine fauna and flora, and setting up a marine aquarium with knowledge of sources of stress, disease, and main influences on this micro-environment.

The course attempts to make students comfortable and compatible with their marine environment through the understanding of ecological principles.

PART I. COURSE OUTLINE

I. Introduction and Overview—The Marine World

II. History of the Marine Environment

- A. Greeks
- B. Marcigli and Denati - dredge
- C. Thompson in Ireland
- D. Brok - chart of bottom
- E. Morey - currents
- F. Voyage of *Porcupine and Lightning*
- G. Challenger
- H. International council for exploration
- I. Jacques-Yves Cousteau
- J. NOAA

III. Geology of Marine Environment

- A. Origins of earth
  - 1. Planetesimal
  - 2. Laplacian
- B. History of earth
- C. Formation of oceans
- D. Undersea formations
  - 1. Sea mounts
  - 2. Basins
  - 3. Ridges
  - 4. Volcanoes
- E. Beach formations
  - 1. Barrier
  - 2. Marginal
  - 3. Spit

IV. Physical Properties of the Marine Environment

- A. Properties of water
  - 1. Density
  - 2. Heat capacity
  - 3. Dissolving ability
  - 4. Transparency
  - 5. Abundance
  - 6. Surface tension
  - 7. Compressibility
  - 8. Viscosity
- B. Density of sea water
  - 1. Salinity effect
  - 2. Temperature effect
  - 3. Pressure effect
- C. Heat budget
  - 1. Radiation budget
    - a. Receipt of solar energy
      - (1) Radiation of earth
      - (2) Convection (winds)
      - (3) The ocean
  - 2. Heat budget in the oceans
  - 3. Surface thermal structure of the oceans
    - a. Seasonal
    - b. Geographic
  - 4. Evaporation, condensation and fog
    - a. Change of state
    - b. Release of latent heat
- D. Waves
  - 1. Simple sinusoidal waves
    - a. Theory
    - b. Speeds
    - c. Types
      - (1) Ripple (6) Tsunami
      - (2) Chop (7) Short
      - (3) Sea (8) Tide
      - (4) Swell (9) Long
      - (5) Beat
  - 2. Other types
    - a. Seiche
    - b. Tidal
  - 3. Wave energy
- E. Tides
  - 1. Cause
    - a. Solar
    - b. Lunar
  - 2. Types
    - a. Spring
    - b. Neap
    - c. Fortnightly
    - d. Diurnal
    - e. Declinational
    - f. Mixed
    - g. Semidiurnal
    - h. Synodic
    - i. Anomalistic
    - j. Bore
  - 3. Rotation of tides

4. Tidal currents
5. Tidal phenomena
   a. Storm surges
   b. Landslide surges
   c. Tsunamis
6. Effects on marine life
   a. Flooding
   b. Transportation of food
   c. Desication

F. Circulation of the oceans
1. Closed-cell surface current systems
   a. Climatic mean ocean currents
   b. Major currents of the world
      (1) North Atlantic Drift
      (2) Gulf Stream
      (3) Humboldt Current
      (4) Others
   c. Driving forces
      (1) Wind
      (2) Coriolis force
   d. Anomolous features of surface currents
      (1) Land influences
      (2) Western intensification
2. Vertical circulation
   a. Upwelling
   b. Convection cells
3. Vertical layering

V. Chemical Properties of the Marine Environment

A. Chemistry of sea water
1. Uniformity
2. Salinity
   a. Ways of expression
   b. Chlorinity
   c. Necessity of standard temperatures
3. Supply of salt from the land
4. Trace elements
5. Sources of sea salt
   a. Volatile materials
   b. Calcium, sodium, potassium, magnesium, carbon, strontium and iodine
6. Conservative versus non-conservative constituents
7. Dissolved gases
   a. Types
   b. Factors influencing distribution
   c. O_2
   d. CO_2
8. Nutrients in the sea

B. Hydrosphere cycle
1. Hydrologic cycle
   a. Definition
   b. Importance
2. Water in atmosphere
   a. Vapor pressure
   b. Absolute humidity
   c. Relative humidity
   d. Dew point
3. Water transfer
   a. Effect of latitude
   b. Influence of land
4. Oceanic reservoir
   a. Vertical distribution
   b. Surface distribution

C. Sediments
1. Sources
   a. Land
   b. Sea - marine
   c. Submarine - volcanic
   d. Crystallized from sea water
   e. Extraterrestrial
2. Transportation of suspended materials
3. Environment for deposition
4. Classification of sediments
   a. Organic
   b. Inorganic
5. Major sediment types
   a. Red clay
   b. Pteropod ooze
   c. Diatomaceous
   d. Globigerina ooze
   e. Radiolarian ooze
6. Rate of sedimentation
7. Importance of sediments
   a. Geological
   b. Historical
   c. Biological

D. Desication
1. Salt spray
2. Intertidal organisms

VI. Biological Properties of the Marine Environment

A. Biological population
1. Plants
   a. Phyla represented
      (1) Spermatophyta
      (2) Pteridophyta
      (3) Bryophyta
      (4) Thallophyta
   b. Distribution
      (1) Plankton
      (2) Benthic
2. Animals
   a. Phyla represented
      (1) Protozoa - single-celled animals
      (2) Porifera - sponges
      (3) Coelenterata - jellyfish and relatives
      (4) Platyhelminthes - flatworms
      (5) Ctenophora
      (6) Nemertinea - ribbon worms
      (7) Entoprocta - minute and stalked animals
      (8) Aschelminthes - rotifers and round worms
      (9) Acanthocephala - spiny-head worms
      (10) Bryozoa - moss animals

(11) Phoronidea - tube worms
(12) Brachiopoda - lamp shells
(13) Echinodermata - spiny-skinned animals, sea stars, etc.
(14) Chaetognatha - arrow worms
(15) Mollusca - clams, snails, etc.
(16) Annelida - segmented worms
(17) Sipunculoidea - peanut worms
(18) Priapuloidea - sausage worms
(19) Echiuroidea - edhiurids
(20) Arthropoda - joint-legged animals
(21) Chordata - (except class Amphibia)-animals with dorsal, tubular nerve cord

b. Distribution
(1) Plankton
(2) Nekton
(3) Benthic

3. General distribution
a. Perimeter of sea
b. Intertidal zone
c. Open sea
d. Sea bottom
4. Worldwide distribution

B. Biological interactions
1. Types
a. Neutralism
b. Competition
c. Mutualism
d. Protocooperation
e. Commensalism
f. Amensalism
g. Parasitism
h. Predation
2. Food chains
3. Energy and nutrient cycles
a. Nitrogen
b. Oxygen
c. Dispersal
d. Isolation

C. Special problems and their solutions
1. Plant
a. Desication
b. Attachment
2. Animals
a. Desication
b. Reproduction
c. Wave action

VII. Man and the Marine Environment

A. Man's affects on the environmental factors
1. Thermal pollution - nuclear reactors
2. Sewage
3. Chemical dumps
4. Oil spills

B. How man benefits the sea
1. Reef building
2. Pollution controls

C. How sea can benefit man
1. Farming the sea
2. Mining the sea
3. Source of fresh water
4. Living in the sea

PART II. RESOURCES AND EVALUATION

A. Texts

The Earth and Its Oceans, Duxbury, Alyn C., Addison-Wesley Publishing Co., Reading, Mass., 1971.

Marine Ecology, Moore, Hilary B., John Wiley and Sons Inc., New York, N.Y., 1966.

The World of Life on the Sea Shore, Cochrane, Jennifer, B.P.C. Publishing Limited, England, 1972.

B. Additional Readings

The following is a partial listing which the student should expand through use of his school and public libraries.

Beaches, Manley, Robert and Manley, Sean, Chilton Book Co., Philadelphia, Pa., 1968.

Beginner's Guide to Seaweeds, Duddington, C.C., Drake Publishers, New York, N.Y., 1971.

Biological Techniques, Knudsen, Jens W., Harper and Row, New York, N.Y., 1966.

The Biology of Estuarine Animals, Green, J., University of Washington, Seattle, Washington, 1972.

The Captive Sea, Phillips, Craig, Chilton Co., New York, N.Y., 1964.

The Edge of the Sea, Carson, Rachel, The New American Library, New York, N.Y., 1955.

Exploring the Ocean Depths, Shenton, Edward H., W.W. Norton and Co. Inc., New York, N.Y., 1968.

A Field Guide to Shells of the Atlantic and Gulf Coasts and the West Indies, Morris, Percy, Houghton Mifflin Co., Boston, Mass., 1973.

Flora of the Sea, Duddington, C.C., Thomas Y. Crowell Co., New York, N.Y., 1966.

Half Mile Down, Beebe, William, Duell, Sloan and Pearce, New York, N.Y., 1951.

Handbook of Basic Microtechnique, Gray, Peter, McGraw-Hill Book Co., New York, N.Y., 1964.

Life in and Around the Salt Marshes, Ursin, Michael J., Thomas Y. Crowell Co., New York, N.Y., 1972.

The Life of the Ocean, Berrill, N.J., McGraw-Hill Book Co., New York, N.Y., 1968.

The Living Sea, Cousteau, Jacques-Yves, Harper and Row, New York, N.Y., 1963.

Marine Chemistry, Horne, R.A., John Wiley and Sons, New York, N.Y., 1969.

Microbial Population of Oceans and Seas, Kriss, A.E., Mishustina, I.E., Mitskevich, N. and Zemsova, E.V., St. Martin's Press, New York, N.Y., 1967.

The New York Aquarium Book of the Water World, Bridges, William, American Heritage Press, New York, N.Y., 1970.

Ocean Life, Marshall, Norman B., Macmillan Co., New York, N.Y., 1971.

Principles of Oceanography, Davis, Richard A., Addison-Wesley Publishing Co., Reading, Mass., 1973.

Research Methods in Marine Biology, Schlieper, Carl, University of Washington Press, Seattle, Washington, 1973.

The Sea Around Us, Carson, Rachel, New American Library, New York, N.Y., 1961.

The Sea Brings Forth, Rudloe, Jack, Alfred A. Knopf, New York, N.Y., 1968.

The Shark: Splendid Savage of the Sea, Cousteau, Jacques-Yves, Doubleday and Co., Garden City, N.Y., 1970.

The Silent World, Cousteau, Jacques-Yves, Harper and Row, New York, N.Y., 1953.

Tropical Marine Aquaria, Cox, Graham F., Grosset and Dunlop, New York, N.Y., 1972.

Under the Sea-Wind, Carson, Rachel L., The New American Library, New York, N.Y., 1941.

Waves and Beaches, Bascom Willard, Doubleday and Co. Inc., Garden City, N.Y., 1964.

The World Within the Ocean Wave, Silverberg, Robert, Weybright and Talley, New York, N.Y., 1972.

World Without Sun, Cousteau, Jacques-Yves, Harper and Row, New York, N.Y., 1964.

C. Periodicals

1. Listed in the *Reader's Guide to Periodical Literature*
   - Audubon
   - Bioscience
   - Conservationist
   - Environment
   - National Geographic Magazine
   - National Wildlife
   - Natural History
   - Oceans
   - Sea Frontiers
   - Science
   - Science Digest
   - Scientific American
   - Smithsonian
2. Periodicals not listed in *Reader's Guide*
   - Journal of the American Littoral Society
   - The Marine Aquarist
   - Marine Hobbyist News

D. Films

The following are some of the better films which may be used in the course:

Encyclopaedia Britannica Educational Corp., Chicago, Illinois
- *The Beach - a River of Sand*
- *Marine Life*
- *The Sea*

McGraw-Hill Films, Hightstown, New Jersey
- *Earth Beneath the Sea*
- *Ocean Currents*

B.F.A. Educational Media, Santa Monica, California
- *Life in the Ocean*

W.A.V.E., Los Angeles, California
- *Restless Sea*

E. Filmstrips

Following is a partial listing of filmstrips which can be ordered from science supply companies:

- The Continental Shelf
- Island Arcs
- Mid-Ocean Ridges
- Obtaining Ocean Bottom Data
- Sea Floor Spreading
- Sub Canyons and Abyssal Plains

F. Teaching Styles

The initial approach is through lecture until the student becomes familiar with the basic material. Following that, most of the time is devoted to field trips and collections which are brought to the lab for continued work. Students work as a class to prepare a booklet containing text and pictures describing the events and findings of the field aspects of the course. Films are shown when appropriate.

G. Student Parameters

Students are required to participate in several field trips which last the entire day. They are also required to make up work in other courses which they missed. Much of the planning for the labs and field trips is done by the students. Biology is a prerequisite.

H. Evaluation

Student progress will be evaluated by observing overt behavior. Other evaluation instruments are built into the course in the form of lab reports, small projects and tests. Final evaluation will be made through individual student-teacher conferences.

I. Modular Configuration

The class meets seven mods per week in a 2-2-3 pattern for three facets.

PART III. DETAILED UNIT

BIOLOGICAL PROPERTIES OF THE MARINE ENVIRONMENT

I. Biological Population

A. Plants
   1. Phyla represented
      a. Spermatophyta - eel grass
      b. Pteridophyta - ferns and grasses
      c. Bryophyta - mosses and liverworts
      d. Thallophyta - algae
         (1) Cyanophyta - blue-green algae
         (2) Rhodophyta - red algae

(3) Chrysophyta - golden brown algae
(4) Phaeophyta - brown algae
(5) Pyrrophyta - fiery red algae
(6) Euglenophyta - euglenoids
(7) Chlorophyta - green algae

2. Types
   a. Submerged
   b. Emergent
   c. Planktonic
3. Distribution
   a. Location
      (1) Benthic
      (2) Plankton
      (3) Intertidal zone
      (4) Spray zone
   b. Factors affecting distribution
      (1) Currents
      (2) Waves
      (3) Light
      (4) Season
      (5) Temperature

B. Animals
1. Phyla represented
   a. Protozoa - single-celled animals
   b. Porifera - sponges
      (1) Hexactinellida - class of deep sea sponges
      (2) Demospongiae - class to which bath sponges belong
   c. Coelenterata
      (1) Anthozoa - xoral
      (2) Scyphozoa - jellyfish
   d. Platyhelminthes - flatworms
   e. Ctenophora - comb jellies
   f. Nemertinea - ribbon worms
   g. Entoprocta - minute, stalked
   h. Aschelminthes
      (1) Rotifera - wheel animalcules
      (2) Nematoda - round worms
   i. Acanthocephala - spiny head worms
   j. Bryozoa - moss animals
   k. Phoronidea - tube worms
   l. Brachiopoda - lamp shells
   m. Echinodermata - exclusively marine
      (1) Asteroidea - sea stars
      (2) Echinoidea - sea urchins
   n. Chaetognatha - arrow worms
   o. Mollusca
      (1) Scaphopoda - tooth shells
      (2) Gastropoda - snails
      (3) Pelecypoda - clams, scallops, oysters
      (4) Cephalopode - squid, octopus
   p. Annelida - segmented worms
   q. Sipunculoidea - peanut worms, exclusively marine
   r. Priapuloidea - sausage shaped worms
   s. Echiuroidea - echiurids
   t. Arthropoda
   u. Chordata - dorsal tubular nerve chord
      (1) Chondrichthyes - sharks and rays
      (2) Osteichthyes - bony fishes
      (3) Reptilia - sea snakes poisonous to man
      (4) Amphibia - only group of animals not found in the marine environment
      (5) Aves - birds
      (6) Mammalia - whales, porpoises, seals, sea cows, walrus
2. Distribution
   a. Plankton
      (1) Protozoa
      (2) Coelenterata
   b. Nekton
      (1) Chondrichthyes
      (2) Osteichthyes
      (3) Mammalia
   c. Benthic
      (1) Echinodermata
      (2) Porifera
      (3) Mollusca
      (4) Some coelenterata
      (5) Most worm forms
   d. Parasites
      (1) Ectoparasites
      (2) Endoparasites

C. General distribution
1. Perimeter of sea
   a. Sandy bottom
   b. Muddy bottom
   c. Rocky bottom
   d. Coral bottom
   e. Combinations
2. Intertidal zone
   a. Plant specializations
   b. Animal specializations
   c. Unique characteristics of environment
3. Open sea
   a. Unique properties of environment
   b. Types of animals present and specializations
   c. Types of plants present and specializations
4. Sea bottom in deep sea
   a. Unique features
   b. Types of animals and specializations
   c. Reasons for absence of plants

D. Worldwide distribution
1. Tropical
2. Temperate
3. Polar

II. Biological Interactions

A. Types
1. Neutralism - no effect on each other
2. Competition

3. Mutualism - both benefit from relationship, obligatory
4. Protocooperation - both benefit, not obligatory
5. Commensalism - one benefitted, other not affected
6. Amensalism - one benefits, other harmed (inhibited)
7. Parasitism - one benefits, other harmed
8. Predation - one benefits, other killed

B. Food chains
1. Organization
a. Producers
b. First level consumers
c. Other level consumers
d. Top consumers
2. Examples
3. Relationship to food webs

C. Energy and nutrient cycles
1. Nitrogen cycle
2. Oxygen cycle
3. Carbon cycle
4. Phosphorous cycle
5. Pathways of solar energy

D. Factors affecting environment
1. Light
2. Food
3. Crowding
4. Dispersal
5. Isolation
6. Habitats
7. Niches

III. Special Problems and Their Solutions

A. Plant
1. Desication
2. Attachment
3. Light
4. Carbon dioxide

B. Animals
1. Desication
2. Reproduction
3. Wave action

PART IV. RESOURCES

UNIT ON THE BIOLOGICAL PROPERTIES OF THE MARINE ENVIRONMENT

The Biology of Estuarine Animals, Green, J., University of Washington Press, Seattle, Washington, 1968.

A Field Guide to Shells of the Atlantic and Gulf Coasts and the West Indies, Morris, Percy, Houghton-Mifflin Co., Boston, Mass., 1973.

Flora of the Sea, Duddington, C.C., Thomas Y. Crowell Co., New York, N.Y., 1966.

Life in and Around the Salt Marshes, Ursin, Michael J., Thomas Y. Crowell Co., New York, N.Y., 1973.

Marine Ecology, Moore, Hilary B., John Wiley and Sons Inc., New York, N.Y., 1966.

Microbial Population of Oceans and Seas, Kriss, A.E., Mishustina, I.E., Mitskevich, N., and Zemsova, E.V., St. Martin's Press, New York, N.Y., 1967.

Ocean Life, Marshall, Norman B., MacMillan Co., New York, N.Y., 1971.

NUTRITION

by George Giffin

OBJECTIVES

The major objective of this course is to present the principles and basic facts of nutrition. Emphasis is placed on the chemistry and physiology of food as it becomes assimulated into the body. Students are made aware of the needs of body tissues and how the body converts food to satisfy these needs.

Most students select the course because they are calorie conscious and concerned with a proper diet. No attempt is made to form diets for individuals; rather, emphasis is placed on recognition of certain essential nutrients which must be supplied for proper body development and function. Considerable time is spent teaching students factors which affect their metabolisms. With this information they can estimate their own caloric requirements and become aware of the wide range of requirements among individuals.

In addition, emphasis is placed on making students consumer conscious: they read labels, check prices, check vitamin and additive contents and read current literature. Students become cognizant of misleading advertisements and can make intelligent decisions regarding choices of foods.

PART I. COURSE OUTLINE

I. Introduction and Overview

II. Need for Rational Approach to Nutrition

III. Things Which Prevent Improvement of Dietary Habits

- A. Ignorance and prejudice
- B. Cultural habits
- C. Fads and false advertising
- D. Complacency
- E. Poverty
- F. Selections available from institutional food services

IV. Types or Classes of Nutrients

- A. Proteins
- B. Fats
- C. Carbohydrates
- D. Water
- E. Vitamins
- F. Mineral elements

V. Functions of Nutrients

- A. Production of energy through oxidation
- B. Building and maintenance of body tissues
- C. Production of regulatory substances
  - 1. Enzymes
  - 2. Hormones

VI. Four Major Food Groups

- A. Grain products
- B. Meat products
- C. Milk group
- D. Vegetable-fruit group
  - 1. Vegetable, defined
  - 2. Fruit, defined

VII. Carbohydrates

- A. Glucose chemical structure
- B. Formation of more complex sugars and starches
- C. Glycogen
- D. Function in the diet
- E. Foods rich in carbohydrates
  - 1. Granulated sugar
  - 2. Chocolates
  - 3. Cereals
  - 4. Cookies
  - 5. Dried fruits
  - 6. Cakes
  - 7. White bread
  - 8. Rice, potatoes, spaghetti, etc.

VIII. Fats

- A. Glycerol
- B. Fatty acids
  - 1. Saturated
  - 2. Unsaturated
- C. Fat-soluable vitamins
  - 1. A
  - 2. D
  - 3. E
  - 4. K
- D. Cholesterol
- E. Function in the diet
- F. Foods rich in fats
  - 1. Butter
  - 2. Beef fat
  - 3. Lamb
  - 4. Margarine
  - 5. Shortening

IX. Proteins

- A. Amino Acids
- B. Peptide linkage
- C. Formation of more complex molecules
- D. Function in the diet
- E. Foods rich in proteins
  - 1. Meats and poultry
  - 2. Fish
  - 3. Cheese
  - 4. Nuts
  - 5. Eggs
  - 6. Cereals, whole grain
  - 7. Legumes
- F. Nine essential amino acids
- G. The twenty amino acids required for human growth
- H. Protein requirements
  - 1. Building new tissues
  - 2. Maintaining tissues
  - 3. Energy source
  - 4. Regulatory functions
    - a. Osmotic pressure
    - b. Water balance
    - c. Acid-base balance of blood or tissues as a buffer
  - 5. Precursors of enzymes, antibodies, and some hormones and vitamins
- I. Factors which influence protein requirement
  - 1. Size
  - 2. Age
  - 3. Completeness of digestion and absorption
  - 4. Nature of the proteins eaten
    - a. Animal
    - b. Plant

X. Energy Requirements

- A. Internal work
- B. External work
  - a. Growth
  - b. Tissue repair
  - c. Heating of body

XI. Metabolism

- A. Anabolism
- B. Catabolism
- C. Rearrangement

XII. Basal Metabolism

A. The irreducible minimum of energy required to keep up life processes

B. The amount of energy required by the body lying at rest in a comfortable environmental temperature, relaxed and without food for twelve to fifteen hours after the last meal

XIII. Calorie

A. A heat measure of energy requirements

B. The large calorie (used in nutrition) is the amount of energy (heat) required to raise the temperature of one kilogram of water one degree centigrade or four pounds of water one degree Fahrenheit

C. An experiment is conducted to show the amount of heat in one calorie

XIV. Major Factors Which Influence Basal Metabolism

A. Body size

B. Age

C. Sex

D. Secretion of endocrine glands
   1. Thyroxine
   2. Insulin

XV. Additional Factors Which Influence Basal Metabolism

A. Sleep

B. Muscle tone

C. Emotions and mental states

D. Exercise

E. Food

F. Fasting

XVI. Factors Influencing Rate of Heat Loss

A. Relative amount of body surface (1" sphere 6:1 or 2" sphere 3:1)

B. Fat layers under the skin
   1. Male
   2. Female

C. Amount of fat in the body

D. Insulation
   1. Clothing
   2. Shelter

E. Environment
   1. Temperature of air
   2. Humidity of air
   3. Movement of air

XVII. Estimation of Energy Requirements for Young Adults

A. Basal metabolism is about one calorie per hour for each kilogram of body weight, for a twenty-four hour period
   1. For male 1 C x 24 hours x weight divided by 2.2 kilo gives - BM
   2. For female .9 C x 24 hours x weight divided by 2.2 kilo gives - BM

B. Activity of the individual requires an additional percentage
   1. Very light: sitting most of day, studying, talking and two hours of walking or standing add 30 percent
   2. Light exercise: sitting, typing, standing, laboratory work and some walking add 50 percent
   3. Moderate exercise: standing, walking, housework, gardening, carpentry add 75 percent
   4. Strenuous exercise: standing walking, skating, outdoor sports, dancing add 100 percent
   5. Severe exercise: sports such as tennis, swimming, basketball, football, running, very heavy work add 150 percent

C. Energy required for production of energy
   1. Obtaining food
   2. Digesting and absorption of food add 10 percent

D. Total of the above three will give an estimate of the total amount of calories used by the individual per day

XVIII. Complete Study of Vitamins and Their Effects

A. A

B. B-1, B-2, B-6 and B-12

C. C

D. D

E. E

F. K

XIX. Food Additives

A. Purposes

B. Positive effects

C. Negative effects

XX. Regulations by Agencies

A. Current regulations

B. Potential regulations

C. Consumer group actions

PART II. RESOURCES AND EVALUATION

A. Texts

Food and Man, Lowengerg, M.E., Wilson, E.D., Feeney, D., and Savage, J.R., John Wiley and Sons, New York, N.Y., 1968.

Nutrition and Physical Fitness, Bogert, Jean, Briggs, George and Calloway, Doris, W.B. Saunders Company, Philadelphia, Pa., 1973.

Nutrition: An Integrated Approach, Pike, R.L. and Brown, M.L., John Wiley and Sons, New York, N.Y., 1967.

B. Periodicals

Family Health
Newspapers — Times and local papers
Newsweek
New York Times Magazine
Prevention
Time
Today's Health
U.S. Department of Agriculture; Food and Nutrition Service
U.S. Department of Health, Education and Welfare

C. Consultants, Outside Speakers and Trips

School dietician
Local doctor
Owner of local health food store
Trip to a local restaurant for Smorgasbord lunch (records of the lunch will be kept and evaluated for calories and food value)

D. Teaching Styles

Initially several lectures familiarize the students with the scope of the program. Later, considerable work is done in small groups within the class. Several reports are required based on student interest. Classes are informal, with time allowed for discussion of individual problems.

E. Student Parameters

All students are expected to attend class regularly. Oral reports are given on a variety of topics. Each student is required to estimate his calorie requirements and record, for a period of time, his approximate caloric intake.

F. Evaluation

Students decide upon realistic goals early in the course. Their grades are self-determined based on their own evaluation of how they achieved. The final grade is reported to the teacher in an individual conference. Students may opt for Pass-Fail.

G. Modular Configuration

The course meets for two mods, twice a week, for two facets. A small class of from ten to fifteen is desirable, but larger numbers can be accommodated.

PART III. DETAILED UNIT

Major Factors Which Influence Basal Metabolism

I. Body Size

A. Metabolism varies with body size, body weight and body shape
B. Three-fourths power of body weight as standard
C. Experiment to find differences in body shapes even though the person's weights are the same
D. Experiment to show effect of loss of heat because of surface area
   1. Pre-natal position for conserving heat
   2. Expanded positions for heat distribution
   3. Measurement of relationship between surface area and volume in different shapes such as a sphere, square, rectangle, etc.
   4. Most effective shape for passing heat to air in relationship to volume of the organism

II. Age

A. High metabolism early in youth
B. Rapid growth requirement for higher metabolism
C. Age when requirement slows down
   1. Question parents
   2. Question former students
   3. Question peer group
D. Gradual slow down in later years

III. Sex

A. Male requirement: about 1 kcal per hour per kilogram of weight
B. Female requirement: about .9 kcal per hour per kilogram of weight
C. Effect of extra layer of fat under skin of female
   1. Swimming at beach when water is cold
   2. Evolutionary requirement for female's extra layer of fat
D. Effect of fat layer preventing heat loss

IV. Endocrine Glands

A. Thyroxine
   1. Effect on growth
   2. Effect on mental development
   3. Effect on sexual development
   4. Hyposecretion
      a. Slower basal metabolism
      b. Storage of fat
      c. Change with age
   5. Hypersecretion
      a. Faster basal metabolism
      b. Function in youth
      c. Nervous jiggle effect
      d. Oxidizing of fat
B. Insulin
   1. Short time effect
   2. Energy release for emergency
   3. Student examples
   4. Body functions just after a nearly serious accident
   5. List of various body functions which are affected

PHOTOGRAPHY

by Louis Mitchell

OBJECTIVES

This course is designed to lay a foundation on which the average student may build a hobby in photography while learning the skills and procedures used by professionals in the field.

In addition to the technical aspects of exposure and printing, etc., the student learns composition, print presentation and special types of photography.

PART I. PHOTOGRAPHY SUBJECT OUTLINE

I. Light

A. Nature
1. Photons
2. Electromagnetic radiation
3. Spectrum

B. Properties
1. Velocity
2. Luminous vs. nonluminous objects
3. Absorption and reflection
4. Behavior
   a. Diffraction
   b. Refraction
   c. Scattering
5. Chemical effects
6. The inverse square law

II. The Camera

A. Needs
1. Film holder
2. Aperture
3. Shutter
4. Film transport

III. Film and Exposure

A. Film
1. Types
2. Sizes

B. Exposure
1. "F" stops
2. Shutter speeds
3. Equivalent settings
4. Flash
   a. Shutter sync.
   b. Guide numbers
5. Depth of field
6. Metering
   a. Types
   b. Techniques

IV. Equipment

A. Cameras
1. Simple
2. Sub-mini
3. 35 mm
4. Roll film
   a. 2¼ square
   b. Larger
5. Cut film
   a. Advantages
   b. Disadvantages
   c. Cost
   d. Use

B. Other
1. Tripods
2. Flash

V. The Darkroom

A. Film developing
1. Tank types and loading
2. Chemicals
3. Time and temperature
4. Washing and drying
5. Negative filing and storing
6. Importance of consistancy

B. Printing
1. The enlarger
2. Paper grades
   a. Picture tone
   b. Contrast
3. Surfaces
4. Chemicals
5. Photo finishing
6. Dry mounting
7. Special techniques
   a. High contrast
   b. Dodging
   c. Burning in
   d. Solarization

VI. Composition and Style

A. Composition
1. Interest point
2. Rule of thirds
3. Selective focus
4. Camera viewpoint
5. Leading lines
6. Arrangement
   a. Triangles
   b. "S" curves
   c. Balance
7. Content
   a. Simplicity
   b. "Busy" pictures

B. Styles
1. What is the meaning of photography?
2. Costs
3. Technical perfection vs. emotion
4. Some famous photographers
   a. Ansel Adams
   b. Edward Weston
   c. Dorothea Lange
   d. Andres Feninger
   e. Ernest Haas
5. Advertising
6. Journalism
7. How to lie with a camera!

VII. Special Topics

A. Portraits
   1. Lighting
   2. Posing
   3. Print presentation

B. Close-up work
   1. Equipment
   2. Problems

C. Night photography
   1. Time exposures
   2. Reciprocity failure in film

D. Copying

E. Multiple exposure and printing

F. Careers in photography

G. Sports

PART II. RESOURCES

A. Texts

Although no textbook is used in this course, several magazines are readily available and are referred to from time to time. Among them are:

Modern Photography
Popular Photography

In addition, Eastman Kodak Company has numerous pamphlets available.

B. Other

At least one field trip is taken to view a photography collection. From time to time local photographers representing the press, commercial and portrait studios are invited to address the class.

C. Teaching Styles

An initial lecture period clarifies terms; this is followed by considerable darkroom work. Students do much of their work during their free periods.

D. Student Parameters

Students should have an adjustable camera. They are expected to take a number of pictures and then print them. A great deal of the work is done individually or in small groups. Permission of the instructor is necessary for course enrollment.

E. Evaluation

Students are expected to attend all classes and in addition, do a considerable amount of work on their own. They must present a montage of pictures, which is used in determining their final grade.

F. Modular Configuration

The class meets six mods per week, for five facets.

PART III. DETAILED UNIT

PRINTING

I. Printing the Negative

A. Selecting a well exposed negative

B. Cleaning and dusting

C. Placing correctly in the enlarger

II. The Enlarger

A. Types
   1. Sizes
   2. Quality
   3. Lenses
   4. Magnification

B. The Easel
   1. Borders
   2. Types

III. The Paper

A. Types
   1. Sizes
   2. Surfaces
   3. Weights
   4. Speeds
   5. Contrast
   6. Prices

IV. Exposure

A. Test strip
   1. Production
   2. Evaluation

B. The Print

C. Change in magnification

D. Change in filters

V. Development

A. Developer
   1. Time
   2. Temperature
   3. Useful life

B. Stop bath
   1. Time
   2. Mixing
   3. Color

C. Fixer
   1. Time
   2. Mixing
   3. Agitation
   4. The two-tone system

VI. Finishing

A. Washing

B. Drying
   1. Matte
   2. Glossy
   3. Resin coated paper

VII. Special Problems and Techniques

A. Dodging
   1. Where?
   2. Why?
   3. How?

B. Burning in

C. Useful "gimmicks"
   1. Soft focus

2. Texture screens
3. Solarization
4. High contrast work
5. Image distortion
6. Vignetting

Teaching Styles

Initially, lectures are used to present the great amount of basic information, relative to the technical aspects of photography. This is needed for the student to master basic techniques in exposure and printing. Specific topics covered are:

Light
Exposure
Basic Development
Equipment

Another style used is problem solving. This is particularly effective in:

Portrait lighting with a polaroid camera to show instant results. The students can arrange lights in various ways to achieve pleasing lighting.

Composition with a large enough array of photographs to choose from; the students should be able to answer why certain pictures "make it" and some don't.

Independent learning (student design), pursued through the development of the student's own portfolio.

Assignments

Have everyone select an important photographer, bring in samples of his work, and be prepared to discuss his style.

Final

Take, develop and print a portfolio of pictures which includes an essay, a scene, a portrait, a lie, a truth, an action picture, and a news picture.

Rumson-Fair Haven Regional High School

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